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ABSTRACT

Research has shown that wait-time (the amount of silence between teacher and student echances) is a part of an interdependent student-teacher interaction system and that the manipulation of this variable has measurable effects on teacher input variables, student outcome variables, and acquisition variables. Since the acquisition of extended wait-time is and has been a major concern in teacher education, an inexpensive, readily accessible wait-time training model was developed and validated. In addition, the effects of extended wait-time on associated discourse variables (including repeated verbal patterns, question frequence and type, compliance moves, and reward patterns) were examined. A written protocol model was used as the training method for a group of 23 inservice teachers. Preservice teachers (N=23) served as the non-equivalent control group. Each subject taught a series of inquiry lessons to a group of four elementary-aged pupils, taped each lesson, and analyzed the wait-time according to procedures in the protocol. Results indicate that teachers could significantly increase their wait-time and could reach criteria (3 seconds) in two sessions. In addition, the teacher-calculated wait-time did not differ significantly with a microcomputer pause analysis apparatus. This desired effect supported the hypothesis that teachers learn and accurately calculate their own wait-time using the written protocol model. (Author/JN)

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The effects of a written protocol model on teacher acquisition of extended wait-time.

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Effective inquiry teaching is dependent upon the quality of student-teacher interaction. The aim of this study is to improve the quality of discussion by training teachers to use the skills of equal access to interaction. Teachers usually control and pace classroom discourse and the pace is normally fast (DeTure, 1979). If teachers are trained to relinquish some of the control of conversation and to decrease the rate of interaction, positive changes in teacher and student behavior begin to occur (Lake, 1973; Riley, 1980; Row, 1973; Tobin, 1979). Teacher interaction variables shown to have an influence on student performance include the frequency and complexity of questions and the amount of silence between teacher and student exchanges (Blosser, 1973; Rowe, 1974; Swift, 1982). This silence or pausing phenomena is known as wait-time.

Training teachers to use extended wait-time and to ask higher order questions is not as easily accomplished as it would appear. Analysis of interaction tapes indicates that teachers have difficulty increasing wait-time I and II to three seconds without extensive training (Garigliano, 1972; Tobin, 1979). DeTure (1976) found video and audio modeling to be a good training technique and Swift (1982) developed a mechanical device providing immediate visual feedback that was reasonably successful. Two problems still exist with wait-time training techniques. Successful procedures require either formal training by an expert such as in schools of education or materials that are expensive and/or not readily available. In addition, about 10-30 percent of the teachers seem to be resistant to training and are not able to achieve the 3 second criterion. (DeTure, 1979; Rowe, 1974; Swift, 1982).

A wide body of research shows that wait-time is a part of an interdependent student-teacher interaction system and that the manipulation of this variable has a ripple effect on the other variables. Rowe (1973) found when teachers use criterion wait-time, the level and frequency of questions asked changes accordingly. Some research evidence suggest that certain verbal characteristics impede the acquisition of extended wait-time. Mimicry and compliance techniques appear to cut into wait-time and Lawlor (1970) noted that the type reward system influenced wait-time. Swift (1982) discovered that teachers engaging in longer pauses ask fewer chaining questions.

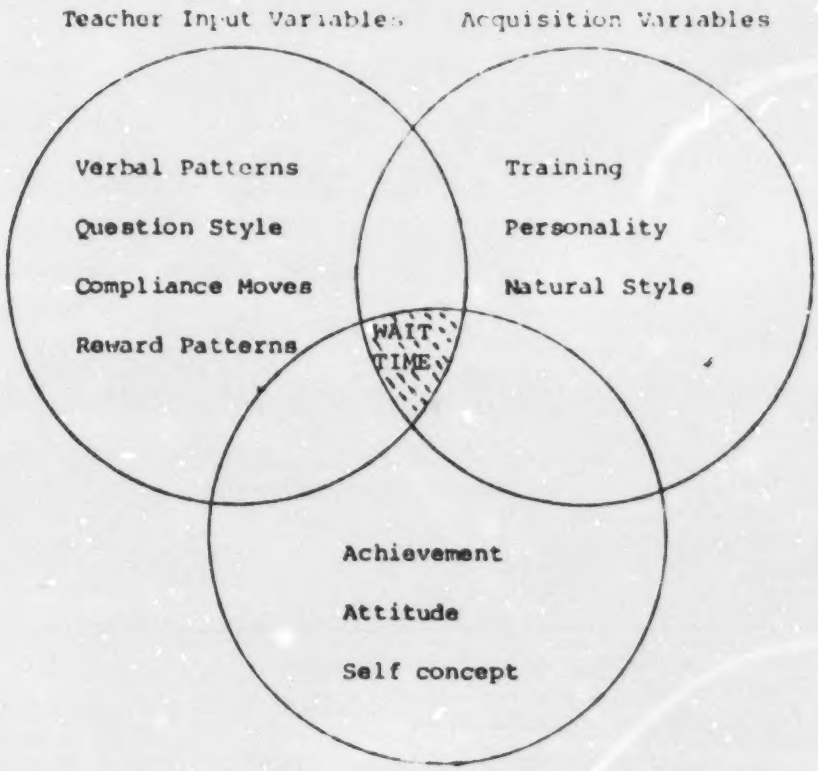
Since some verbal characteristics of teachers appear to interfere with a slower, more reflective type of interaction, the question is raised as to whether discourse style may be a function of personality type (McCaulley, 1976). As yet the acquisition of wait-time as it relates to personality type has received little attention. The next phase of this research is to examine the effect of personality type on the acquisition of criterion wait-time will be studied.

There are several purposes of this study. The first is to develop and validate an inexpensive, readily accessible wait-time training model. The second purpose is to examine the effects of extended wait-time on associated discourse variables including repeated verbal patterns, question frequency and type, compliance moves and reward patterns.

PLAN FOR THE PROPOSED STUDY

Synopsis and Hypothesis

An extensive review of the literature suggests the probability of an interdependence of the variables related to wait-time being examined in this study. These may be categorized into three groups. The teacher input variables form one cluster and the student output variables including achievement, attitude, and self concept form another. The impinging acquisition variables of training and personality comprise the third. The interrelationship of the variables is illustrated with a diagram. Wait-time is the intersect factor of the 3 clusters.



The specific hypotheses in the study related to the training model and teacher interaction variables are grouped accordingly. The following research hypotheses were tested:

A. Training model

1. Teachers trained with a written protocol model will engage in significantly longer wait-time than teachers not using the model.

2. Teacher wait-times calculated from the protocol procedures will not differ significantly from the wait-times calculated using a micro computer based wait-time analysis apparatus.

B. Teacher Interaction Variables

Teachers who engage in criterion wait-time will:

3. significantly decrease the frequency of questions.

4. will ask significantly more high level questions according to the Blosser system of classification (Blosser, 1973).

5. will engage in significantly fewer repeating verbal patterns.

6. will significantly reduce nonspecific rewards.

SUBJECTS

The written protocol model was employed as the wait-time training technique in a science methods class for a group of 23 inservice teachers at the University of Georgia. Each of the teacher subjects taught a series of two or more science inquiry lessons to a group of four elementary age pupils in a micro teaching setting. The subjects tape recorded each lesson and analyzed wait-time according to protocol. The Myers-Briggs was administered to each teacher subject. The non-equivalent control group consisted of 23 University of Florida preservice teachers.

DESIGN

The main effects examined in this study are the effects of a written protocol on the acquisition of extended wait-time. The design employed is a quasi-experimental non-equivalent control group design, (Stanley & Cambell, 1963). Since the purpose of training is to work with naturally assembled groups, it is more feasible to utilize this design than to sacrifice sample size for the sake of randomization. To validate the protocol procedures for measuring wait-time, the teacher calculated wait-times were compared with the computer analyzed wait-times using a two way analysis of variance.

When examining the teacher input variables, comparisons were made between teacher's response before achieving criterion wait-time and after achieving 3 second wait-time in a pretest-posttest design.

Threats to internal validity are controlled partially with design although there are some inherent weaknesses with the design. The problem of selection and maturation interaction is not likely to occur due to the short duration of time between pre and posttest samples. Instruction within the protocol model are aimed toward preventing problems with reactive effects and the interaction of treatment and testing. Threats to external validity are somewhat controlled with the quasi-experimental design. The model is

designed to help overcome the problems usually associated with generalization.

PROCEDURES

Development of the Protocol Model

Sufficient data have been gathered over the past decade to substantiate the importance of incorporating pausing time into student-teacher dialogue. Despite this, a relatively small percentage of classroom teachers have received sufficient training to be able to use wait-time effectively in discussion. Simply being made aware of the phenomena in no way assures the usage of wait-time (Swift, 1982). The model was designed to capitalize on the principals of observational learning (Bandura, 1971). Although video and audio models are usually superior to other kinds of models, a written model has been shown to be effective (Koran, 1971, 1972).

A written model serves as the initial treatment with the transcribing calculation procedures being a part of the treatment. Participants are required to transcribe the tape and compute their wait-time averages. To accomplish these tasks, the subject must focus on the phenomena and attend to the cues aurally, visually and kinesthetically. This combination of responses to the wait-time stimulus is intended to insure that the desired learning takes place. The feedback component, which is a part of the training process, has been shown to be an effective strategy for altering behavior (McDonald and Allen, 1976).

The protocol model is divided into parts. In the introduction, the pausing phenomena is discussed and the significance of its impact on discussion is supported with an abbreviated literature review. Next the basic concept of wait-time and the descriptive terms are diagrammed to visually illustrate the interrelationship of the variables helping the reader to better conceptualize the procedures called for in the actual protocol. The training section consists of a series of sequential activities which explain how to teach the inquiry task, transcribe the tape and calculate the wait-times.

Participants are cautioned to follow the procedures as written to avoid confounding the results. The silences measured have to be intended pauses and not silence in which the pupils are engaged in nonverbal activities.

A sample transcript is included to illustrate how the results should look and to clarify the calculations for wait-time. Finally, an inquiry lesson is included to make the model an entire learning packet. The materials needed, including a stop watch and tape recorder are inexpensive and easily available.

Data Collection and Instrumentation

Since the model is intended to be self-instructional, arrangements were made to have the data collected by a disinterested party. The materials were utilized in a science methods class as the sole wait-time training procedure. Audio tapes were provided for the data collection of each inquiry session. As requested in the protocol, the teacher subjects recorded, transcribed and calculated their wait-times for the two or three sessions. When doing research on interaction variables, data are customarily collected via tape recordings. The non-equivalent sample group taught and recorded a similar inquiry lesson without the benefit of wait-time training. Data on all the input variables were tabulated from the tapes and transcripts.

The audio tape recordings and transcripts were the principle collection instruments. In order to get wait-time calculations of sufficient accuracy and reliability for research purposes, the utilization of a mechanical tracking device is required. An instrument yielding consistently reliable results is a servo-chart recorder such as the Heathkit Model EU20B. A trained moderator annotates the speaker and wait-time specie on the chart paper as the tape plays. Recently, Gooding and Swift (1982) developed a microcomputer based pause analysis apparatus that is superior to the servo-chart recorder in efficiency and accuracy. The data were analyzed using microcomputer apparatus. In addition to formal analyses of hypotheses, descriptive statistics were calculated. Main effects

for pretest posttest difference wi h wait-times I and II were tested with a two way analysis of variance (Kirk, 1968).

RESULTS

The primary goal of this study was to validate a written protocol model designed to train teachers to use three second wait-time. A second goal was to examine teachers' verbal interaction to gain a better understanding of the wait-time acquisition patterns. The written model called for a teaching cycle that was to be repeated until criterion wait-time was reached. Base line wait-time data for pretrained subjects was calculated for a non-equivalent control group. The mean and standard deviations for wait-time I and II of the pretrained group are as follows:

Wait-time I, mean = .99, S.D. = .57;

Wait-time II, mean = .60, S.D. = .45.

The first lesson was conducted after students gained a conceptual understanding of the concept but before the transcription and analysis of wait-time. No one achieved three second wait-time I or wait-time II in one try. Upon completion of the second lesson after which students completed the second phase of training using their tape and transcript from lesson 1, seventy percent reached three second wait-time. The remaining thirty percent reached criterion in three trys. Significant differences were found between the first lesson done prior to transcription and the final teaching lesson which occurred after treatment. See Table 1 for means and standard deviations of both student calculations and the computer analysis of wait-time I and II.

TABLE 1

Means and Standard Deviations for Wait-Time I & II

	Wait-Time I		N	Wait-Time II		N
	Presession	Postsession		Presession	Postsession	
Student						
Mean	1.39	3.29	20	1.02	4.71	21
S.D.	.71	.73		.89	2.24	
Compute	1.47	3.30	19	.87	4.95	20
Mean	.50	1.06		.45	2.34	
S.D.						

In order for the written protocol model to be a valid training device, the subjects had to be able to calculate their own wait-times accurately. By comparing teacher calculated wait-time with computer analyzed wait-time, it could be shown that the protocol procedures were effective. No significant differences were found between teacher calculations and the computer analysis. The analysis of variance summary data are reported in Table 2, wait-time I, and Table 3, wait-time II.

TABLE 2

Analysis of Variance for Wait-time I

Source	SS	df	MS	F
Main effects	66.69	2	33.34	54.98 *
Stud-Comp(SC)	.036	1	.036	.061
Pre-Post(PP)	66.60	1	66.60	109.81 *
Interaction SCXPP	.030	1	.030	.824
Explained	66.94	3	22.31	36.79 *
Residual	44.27	73	.061	
Total	111.12	76	.146	

*$p < .001$

TABLE 3

Analysis of Variance for Wait-Time II

Source	SS	df	MS	F
Main effects	288.73	2	144.36	50.46 *
Stud-Comp(SC)	0.038	1	0.038	0.13
Pre-Post(PP)	288.57	1	288.57	100.86 *
Interaction	0.745	1	.0745	0.261
SCXPP	0.745	1	.0745	.261
Explained	288.78	3	96.26	33.65 *
Residual	208.85	73	2.86	
Total	497.64	76	6.548	

*p< .001

The teacher interaction variables that were tested in relation to the subject's acquisition of wait-time included question type and frequency, repeated verbal patterns and reward schedules. Questions were analyzed according to Blosser's system of classification (1973). A repeated verbal pattern was defined as any phrase repeated by the teacher more than five times during the interaction sequence. Mimicry, in which the teacher repeats all or a portion of a student's response, was considered a second type of repeated verbal pattern. Rewards were classified as neutral, positive or negative. The frequency of negative feedback was so low (8 specific examples from 3 teachers for all sessions) that the variable was deleted from analysis.

In addition to question type and frequency, two special categories of questions, rhetorical and chaining questions, were examined. In previous studies both of these were found to interfere with wait-time acquisition. Using Blosser's classification the questions were categorized as closed; cognitive memory or convergent thinking and open, divergent thinking or evaluative thinking. The incidence of the latter was extremely low. The means and standard deviations for all questions, pre and post training, are reported in Table 4.

TABLE 4

Means and Standard Deviations for Questions

	Short WT		Criterion WT		F value
	M	SD	M	SD	
Frequency	3.80	2.13	3.71	0.72	*6.33
Type					
Cognitive Mem.	11.47	5.60	6.52	3.18	
Convergent	6.00	3.01	4.84	3.09	
Divergent	5.53	3.61	7.74	4.33	
Rhetorical	1.42	1.50	0.15	0.50	
Chaining	4.00	4.24	3.89	7.25	.003

Upon achieving three second wait-time, teachers reduced their question frequency significantly from 3.8 q/minute to 2.17 q/minute. The number of cognitive memory questions was significantly reduced with extended wait-time. The only question type to increase with wait-time was divergent thinking. Relatively few rhetorical questions, where the teacher does not expect an answer or answers her own question, were asked. No significant differences were found between the number of chaining questions asked with longer and shorter wait-time.

TABLE 5

ANOVA for Question Type

Source	SS	df	MS	F
Main effects	1420.52	4	355.13	29.77 *
Question type(QT)	1357.34	3	452.45	37.93 *
Pre-Post(PP)	63.18	1	63.18	5.29 **
Interaction ATXPP	243.65	3	81.22	6.81
Explained	1664.18	7	237.74	19.93
Residual	1717.56	144	11.93	
Total	3381.74	151	22.39	

*$p < .001$
*$p < .05$

Repeated verbal patterns characterized 85 percent of the interactions and 35 percent contained the pattern of mimicry. Both of these were significantly reduced when longer wait-time was employed. The reward pattern changed significantly. Teachers tended to use a high number of non-specific neutral rewards and relatively few positive rewards. Negative rewards and/or corrective feedback were essentially absent. Both neutral and positive rewards were significantly reduced with extended wait-time. Means and standard deviations are found in Table 6. Summary statistics for analysis of variance are found in Table 6.

TABLE 6

Means and Standard Deviations

for Verbal Patterns and Rewards with F values for ANOVA

	Short WT		Criterion WT		F value
	M	SD	M	SD	
Verbal Patterns					
Repeated	12.0	6.61	3.25	3.31	*16.88
Mimicry	9.8	4.88	1.0	.67	* 6.08
Rewards					*21.65
Neutral	13.32	10.75	3.63	3.46	
Positive	2.95	3.39	0.68	1.15	

*p. <.01

Discussion

The main objective of the study was to test a wait-time training model to determine whether teachers could learn to use wait-time effectively, and to discover whether their estimations of wait-time were reasonably accurate. The results indicate a written model is a successful training device and that the teachers' calculations of wait-time are surprisingly close to the more accurate computer calculations. Over the past decade wait-time has been demonstrated to have an impressive impact on teachers' interaction behavior and on students' learning outcomes.

Successful, inexpensive, readily available training techniques have been woefully absent. While wait-time is often discussed in colleges of education, formal training is relatively infrequent. However, research shows that an awareness of the concept does not generalize to actual classroom practice. Most teachers cannot effectively and consistently use extended wait-time without a training technique that provides a model and/or feedback. Hopefully, this research will help solve the problem. The protocol model is designed to be self-instructional providing inservice as well as preservice teachers with a better opportunity to learn to use wait-time and improve the quality of interaction.

A second purpose of the study was to examine related teacher verbal behaviors to determine the impact of extending wait-time on the overall interaction patterns. With short wait-time teachers ask approximately four questions per minute with a significantly higher number of those being cognitive memory questions. The majority of teachers use a verbal pattern repeatedly, the most common ones are "all right" and "okay now". About one third of the subject used mimicry consistently. While the incidence of neutral rewards was high, the number of positive reward was low and negative reward and corrective feedback was practically non-existent. About half of the repeated verbal pattern were used in the context of a neutral reward. Interestingly regarding negative feedback, instead of responding to an individual's answer with feedback concerning the appropriateness of the response, the teacher simply redirected the question to another student. It was not unusual for the teacher to redirect the question four or five times before moving to a new question sequence. The teacher redirected the question by calling different students by name.

With three second wait-time the interaction pattern changed. The teacher asked about half as many questions but a larger proportion of the questions were open involving divergent thinking. The number of repeated verbal patterns was drastically reduced. Teachers still gave relatively little positive or negative feedback. However, instead of redirecting a question by calling students by name, she asked a question and allowed time for an array of responses. While student learning outcomes were not the focus

of the study, it was noted that confusion decreased and the level of response increased in complexity. In general the quality of the discourse improved with the slower paced instruction.

In conclusion, the results supported the hypothesis. Teachers can learn to use extended wait-time by following the procedures in the protocol model. When teachers engage in criterion wait-time; the teacher's verbal interaction pattern change in a positive direction and quality of discourse is heightened. The data in this study add to and support other related inquiry interaction studies. With the validation of the model, a new study is planned to examine the characteristics of teachers who have difficulty acquiring extended and maintaining slower paced interaction.

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